

**COLOUR-BASED IMAGE RETRIEVAL ALGORITHMS BASED ON
COMPACT COLOUR DESCRIPTORS AND DOMINANT COLOUR-
BASED INDEXING METHODS**

AHMED TALIB ABDULAMEER

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Abstrak

Capaian imej berasaskan kandungan (CBIR) dilaporkan sebagai salah satu bidang penyelidikan yang paling aktif dalam dua dekad lalu. Tiga masalah prestasi CBIR ialah ketidaktepatan dapatan semula imej, kerumitan yang tinggi ciri pengekstrakan, dan penurunan semula imej selepas pengindeksan pangkalan data, menyebabkan CBIR tidak sesuai digunakan pada peranti mudah alih. Objektif utama tesis ini adalah untuk meningkatkan prestasi CBIR. Untuk mencapai objektif ini, tiga kaedah telah digunakan. Kaedah pertama menggunakan imej warna dominan (DC) dipilih sebagai penyumbang utama untuk tujuan ini kerana ciri yang kompak dan keserasian dengan sistem visual manusia. Capaian semula imej berasaskan semantik adalah dicadangkan untuk menyelesaikan masalah capaian yang tidak tepat dengan menumpukan pada objek imej. Kesan latar belakang imej dikurangkan untuk memberi tumpuan lebih kepada objek dengan memberikan pemberat untuk objek dan latar belakang DC. Nisbah peningkatan ketepatan ditingkatkan berbanding kaedah yang dibandingkan. Rangka kerja DC pemberat adalah dicadangkan untuk mengitlak teknik ini di mana ianya ditunjukkan dengan menggunakannya pada perihalan warna. Manakala untuk mengurangkan kerumitan yang tinggi pada warna Correlogram daripada segi pengiraan dan ruang memori, kaedah kedua perwakilan padat Correlogram dicadangkan. Langkah persamaan yang sedia ada berasaskan DC Correlogram disesuaikan untuk meningkatkan ketepatannya. Kedua-dua kaedah digabungkan untuk menghasilkan pemerihal warna yang baik dari segi masa dan memori kerumitan ruang. Hasilnya, ketepatan telah ditingkatkan berbanding kaedah yang sedia ada dan ruang memori dikurangkan 10% kurang daripada ruang asalnya. Peralihan warna ke dalam beberapa rangka kerja DC dicadangkan untuk mengitlak konsep DC. Selain itu, kedua teknik pengindeksan berasaskan DC dicadangkan untuk mengatasi masalah pengindeksan dengan menggunakan RGB dan ruang warna persepsi LUV. Kajian ini menyumbang kepada pengurangan ruang carian pangkalan data serta pada masa yang sama memelihara ketepatan yang sama capaian imej berasaskan kandungan.

Kata kunci: Capaian imej berasaskan kandungan, Correlogram warna dominan, Pengindeksan berasaskan warna, Perihalan warna padat.

Abstract

Content based image retrieval (CBIR) is reported as one of the most active research areas in the last two decades, but it is still young. Three CBIR's performance problem in this study is inaccuracy of image retrieval, high complexity of feature extraction, and degradation of image retrieval after database indexing. This situation led to discrepancies to be applied on limited-resources devices (such as mobile devices). Therefore, the main objective of this thesis is to improve performance of CBIR. Images' Dominant Colours (DCs) is selected as the key contributor for this purpose due to its compact property and its compatibility with the human visual system. Semantic image retrieval is proposed to solve retrieval inaccuracy problem by concentrating on the images' objects. The effect of image background is reduced to provide more focus on the object by setting weights to the object and the background DCs. The accuracy improvement ratio is raised up to 50% over the compared methods. Weighting DCs framework is proposed to generalize this technique where it is demonstrated by applying it on many colour descriptors. For reducing high complexity of colour Correlogram in terms of computations and memory space, compact representation of Correlogram is proposed. Additionally, similarity measure of an existing DC-based Correlogram is adapted to improve its accuracy. Both methods are incorporated to produce promising colour descriptor in terms of time and memory space complexity. As a result, the accuracy is increased up to 30% over the existing methods and the memory space is decreased to less than 10% of its original space. Converting the abundance of colours into a few DCs framework is proposed to generalize DCs concept. In addition, two DC-based indexing techniques are proposed to overcome time problem, by using RGB and perceptual LUV colour spaces. Both methods reduce the search space to less than 25% of the database size with preserving the same accuracy.

Keywords: Content-based image retrieval, Dominant colour correlogram, Colour-based indexing, Compact colour descriptors.

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List of Abbreviations

ANMRR	Average Normalized Modified Retrieval Rank
AP	Average Precision
ARR	Average Retrieval Rate
BIC	Border/Interior Pixel Classification
BOVW	Bag of Visual Words
CBIR	Content-based Image Retrieval
CBIRS	Content-based Image Retrieval System
CCV	Colour Coherence Vectors
CLEF	Cross Language Evaluation Forum
ColGrm	Colour Correlogram
CSD	Colour Structure Descriptor
DC	Dominant Colour
DCBC	Dominant Colour-based Correlogram
DCD	Dominant Colour Descriptor
DQM	Dynamic Quantization Method
EMD	Earth Mover's Distance
FV	Feature Vector
GB	Giga bytes
GCD	Global Colour Descriptor
GLA	Generalized Lloyd Algorithm
HSV	Hue, Saturation, Value Colour Space
k-NN	k-Nearest Neighbours
LBA	Linear Block Algorithm
LUV	Adams Chromatic Valence Colour Space
MAP	Mean Average Precision
MB	Mega bytes
MP7DCD	MPEG-7 Dominant Colour Descriptor
MPHSM	merging palette histogram for similarity measure
NMRR	Normalized Modified Retrieval Rank

NN	Neural Networks
P	Precision
QBE	Query by Example
QBS	Query by Sketch
QSM	Quadratic Similarity Measure
R	Recall
RGB	Red, Green, Blue Colour Space
RF	Relevance Feedback
SCD	Spatial Colour Descriptor
SM	Similarity Measure
SOM	Self-Organization Map
SVM	Support Vector Machines
WDCD	Weighted Dominant Colour Descriptor

CHAPTER ONE

INTRODUCTION

1.1 Introduction

The widespread of digital images and availability of huge storage space led to emergence of massive image collections, which are called *digital image libraries* (Attig, Copeland & Pelikan, 2004). These digital libraries spread on the Internet through the progress of transmission techniques. The wealth of available digital data, especially images, has introduced a problem to those who are seeking information in the digital libraries. This problem lays in managing and organizing these digital image libraries (databases). Therefore, *Indexing and Retrieval* concepts were introduced; *Indexing* relates to “how to store images in database and to retrieve them later (through querying) efficiently”, whereas *Retrieval* relates to “how to retrieve images that are relevant to the query from images’ database”. Both concepts relate with the question of “how to speed up retrieval of the relevant images from databases?”

There are two methods to retrieve images from digital library according to Torres and Falcao (2006). These methods are generally known as image retrieval methods. The first method is Annotation-Based Image Retrieval (ABIR) that depends on metadata associated with each image and use traditional query techniques to retrieve images from database by a keyword (Mehyar & Atoum, 2012; Torres & Falcão, 2006). There are two disadvantages in this method (Chang, Tsai & Chou, 2013; Eitz, Hildebrand, Boubekur & Alexa, 2010; Poursistani, Nezamabadi-pour, Askari Moghadam & Saeed, 2013). Firstly, it requires annotation of all images in the

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